BALANCING CONSERVATION AND LIVELIHOOD ISSUES IN PROTECTED AREA OF WESTERN ODISHA, INDIA

Abstract

India's forests are home to remarkable plant and animal biodiversity. The country is among the 17 "megadiversity" countries. Protected Areas in India cover about 14.8 million ha. Representing about 14 per cent of the forest area, consisting of 80 national parks, 441 wildlife sanctuaries and 8 Biosphere reserves (Government of India). However, the condition of several protected areas is poor, because of fire, grazing, and inadequate management. Most of the Protected Areas are not covered by comprehensive management plans. There has been a history of disagreement between wildlife conservationists and human rights activists over the best way to manage wildlife habitats. While wildlife conservationists stress the need to prioritize wildlife protection, human rights activists have been frequently opposed to Protected Areas because of the human rights implications. Over the last few years there has been continuous efforts initiated by civil society organizations to find a middle path and building bridges between local communities, conservationists and human rights activists. The present paper highlights the findings on rich and scientifically relevant ethno-ecological knowledge of tribal forest dwellers & the study focus on the evaluating the findings and build the rationale for incorporation of such knowledge systems in shaping up principles for effective co-management in Protected Areas in western Odisha i.e Karlapat & Sunabeda sanctuary.

Keywords: Traditional knowledge, Co-management, Protected Area, Indigenous knowledge, Biodiversity, Sanctuary, Food science, Shifting Cultivation.

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I. INTRODUCTION

Protected Areas (PA) are defined as "An area of land or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources and managed through legal or other effective means" (Gadgil and Guha, 2002). WLPA created three kinds of PAs: sanctuaries, national parks and closed areas (Global Biodiversity Strategy, 1992). Under the WLPA, 1972, certain areas were declared legally protected (Protected Area) by the government because of their high ecological or biodiversity value. There has been a history of disagreement between wildlife conservationists and human rights activists over the best way to manage wildlife habitats. While wildlife conservationists stress the need to prioritize wildlife protection, human rights activists have been frequently opposed to Protected Areas because of the human rights implications.

II. PROTECTED AREA MANAGEMENT IN INDIA

PA management, in the Indian context, has become interplay of faulty policies that have largely disregarded the rights of people living inside PAs. Over the years, wildlife conservationists and human rights activists have been at loggerheads with each other over the underlying management objectives and operational strategies applied to PAs. Each side looks at PA management from its own perspective; the scientific conservation lobby believes in biodiversity conservation in isolation of local people, while the human rights lobby looks at it from the material ground of securing the livelihoods of millions who depend on forest resources. The colonial mindset, with its emphasis on exclusionary model of protection, has survived even after independence as exemplified by conservation legislation such as WLPA (Pathak, et.al. and Gadgil et al 1995).There are sound arguments against PA management models that don't take into account the concerns of local people.

III. SUNABEDA AND KARLAPAT IN CONTEXT

Series of studies have been conducted on certain sanctuaries in Odisha there is very sparse literature and studies available on Karlapat and Sunabeda. In Karlapat and Sunabeda there are homogenous tribal groups who have been living in relative seclusion. The communities, over the years, have been earning their survival from the forests and forest lands. These resource dependent communities, in their socio-cultural life, have been conserving the forest resources. Forest is the life world for them. The local communities have exhibited inextricable link with the local biodiversity which provides to their various necessities and hence are very knowledgeable about the flora and fauna and their interactions over the area. In both the sanctuaries the forest is well stocked, diverse.

The present chapter is to record the tribal people's knowledge on biodiversity which is both objective and subjective. Emphasis has been given to the study ethnographic details of plants and trees in relation to the tribals' social and cultural life. This is because; their understanding of plant world has both utilitarian and cognitive aspects which find manifestation in their social and cultural way of life. In this approach to ascertain the domain of knowledge of the tribals on biodiversity, participation in their social and cultural life was most inevitable.

IV. METHODOLOGY OF STUDY

It is a multidisciplinary study. It is descriptive as well as analytical. The methods of research utilised in descriptive studies are survey methods of all kinds, including comparative and co relational. The descriptions of the happenings have been analysed to make a critical evaluation of the material. The applicability of this method in case of biodiversity related studies can be clearly envisaged from describing the use of plants by the people in their socio-cultural life and evaluating the people's knowledge on the subject as well as the implications of the knowledge.

V. DATA COLLECTION

The following methods were used for data collection in this piece of research.

1. **Primary source :** Field Work, From Informants, preservation of data
2. **Secondary resources:** Books, journals etc, Study/research reports, Libraries

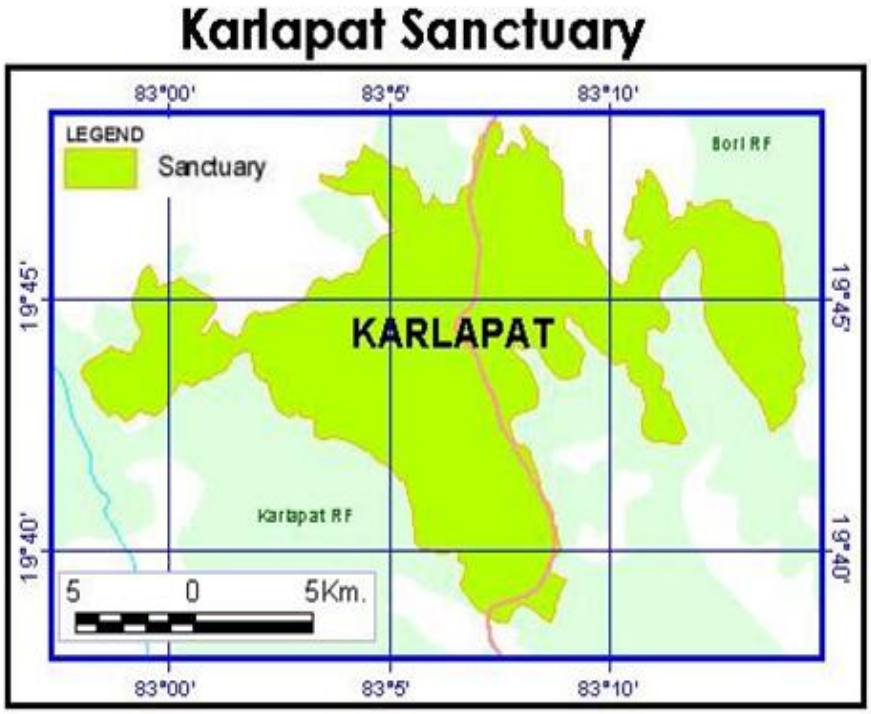
VI. STUDY AREA

Protected area of Western Odisha i.e Karlapat & Sunabeda sanctuary is taken as study area for Co-management options with relevance to Indigenous and Traditional Knowledge in food science.

VII. KARLAPAT

Karlapat Wildlife Sanctuary is situated in the district of Kalahandi between 82° 45' to 83° 15' East Longitude and 19° 30' to 19° 50' North Latitude. It covers an area of 175.503 sq. km comprising 70.77 sq km of Karlapat R.F., 39.56 sq. km. of Nehela R. F., 20.84 sq. km. of Jugsahipatna R. F., 27.54 sq. km. of Jerka R. F., 10.69 sq. km. of Sagada P. R. F. and 6.10 sq. km. of a part of Jugsahi extension P. R. F. The orest is mainly of dry deciduous type with patches of riparian semi evergreen forest along the hill streams. The Sanctuary is under the range of Kalahandi South Division, Bhawanipatna Circle; Notified vide Notification No-10772-8F (W) 40/88 dated 10.5.1988.

Karlapat gets its name from "Kalra Patria Bagha" meaning Tiger with stripes resembling Bitter Gourd leaves means the 'leopard'. The name itself demonstrates the rich biodiversity that includes many floral and faunal species. There are 19 villages having approximate population of 2000 inside the sanctuary which can be termed Traditional Use Zones. This would extend over a distance of 8-10 KM. The indigenous tribe inhabited in the forest belongs to Kondh community sustaining upon NTFPs and hill agriculture mostly shifting cultivation.



VIII. SUNABEDA

Sanctuary is located on the western side of the Nuapara District bordering Chattisgarh State within 82 20' to 82 34' 42" longitude and 2024' to 24 44' latitude. It is at height of 2150 feet from mean sea level (A brief note on Sunabeda Wild Life Division, Mr.H.K.Bist, D.F.O, Sunabeda Division, 2001). The Sanctuary seem to be holding a unique appearance as the sunabeda plateau is placed on the hill top and contains flat land with plenty of edible grass. There are series of hill ranges running through Gatibeda and Patadhra forest blocks amidst which the sunabeda Plateau is located. Geographical area of the sanctuary embraces forests range of Nuapada and Komna blocks and comprises of around 600 Square Kilometer. The wildlife sanctuary harbors a great diversity of floral and faunal habitats with vast plateau and canyon like valleys. Dry deciduous forests along with eleven waterfalls adorn the length and breadth of the Sanctuary. The demarcated core and buffer Zone of the sanctuary contain 243.60 Square Kilometer and 356.40 Square Kilometer respectively (Forest Department, Government of Orissa).

The first notification for declarations of Sunabeda Wildlife Sanctuary dates back to 26th July 1983 vide letter no.16045/FFAH. The final notification was issued on 10th May 1988 vide letter no. 10772/FFAH. In Sunabeda, the demarcated boundary of the wild life sanctuary area was first declared vide office order no. 5023 dated 15.11.97 by the collector of Nuapada. Presently there are four Gram Panchayats namely Sunabeda, Soseng, Bharuamunda and Kermeli consisting of 30 Revenue villages, which are coming under sanctuary area.

Co-management of PAs: The issue of co-management of PAs seems especially relevant in India in view of the global consensus on managing PAs for biodiversity conservation by forging a close relationship with local people. CBD in 1992, among other things, laid emphasis on *in-situ* and *ex-situ* conservation, besides sustainable utilization of biodiversity

and participatory management of PAs. India committed to Convention on Biodiversity for "Full and effective participation by 2008, of indigenous and local communities, in full respect of their rights and recognition of their responsibilities, consistent with national law and applicable international obligations and the participation of relevant stakeholders in the management of existing and the establishment and management of new, protected areas." This was simplified by Ministry of Environment and Forests, Government of India as 'moving towards full participation of adivasis and other local communities to participate in the planning and management of PAs, to provide them full benefit from PAs, to respect their traditional rights to forests and its resources and to seek their consent before considering their resettlement outside PAs. But it is irony to state that not a single protected area in India has come under a fully participatory model of governance even though India is committed to move all its protected areas towards a participatory model.

IX. ECOLOGICAL PERCEPTIONS IN SHIFTING CULTIVATION

The Bhunjia Tribes of Sunabeda Sanctuary used to practice shifting cultivation traditionally since long. Many patches in forest adjacent to Kondh and Bhunjia villages in and around Karlapat and Sunabeda had been cultivated earlier which have been lying fallow since years due to the strict vigilance of wildlife department to restrict forest clearing. However, the practice has been stopped since last 15-20 years partly due to restrictions on shifting cultivation and partly due to settled cultivation on forestland, although in remote areas the shifting cultivation has been going on.

Shifting cultivation is one such area of their interaction with forest ecosystem which showcases age old wisdom in managing environment security and food security and disseminates treasures of indigenous knowledge systems. It is one of the primary means of earning livelihoods for many tribal communities inhabiting mountainous regions of the state.

It is synonymous with slash and burn cultivation, swiddening, *jhum*, fallow farming, *podu*, *nella* and many other local denominations.

X. PRACTICES IN SHIFTING CULTIVATION

Swiddening is a sort of rain fed agriculture on hill slopes. In certain places there may be perennial streams found that is used for making the floor moist by diverting the course of streams and channelizing water into swiddens. However, all swiddening sites may not have such opportunities. So, rain is the only measure that provides moisture to the swiddens. Before the showers the soil remains almost dry because of burning of slashes in the swiddens. During the first shower of rain the soil absorbs all the rain water but it is not enough for creating conditions for seed germination. Hoeing the soil after the first shower is also not very common. Before the sowing time, sometime in April, one or two showers of rainfall occurs. It is during that time, if burning of slashes had been completed, people do light hoeing of the swidden floor to trap moisture from the rainfall that occurs later.

Sowing is done when the moisture regime of soil in swiddens is optimal and after the pre sowing religious practices are done. Sowing of multiple crops follows a pattern. The cereals are usually broadcasted. From experience people know how much of crops the swidden can foster. People make an assumption of possible germination percentage. Expecting that the rate of germination and recruitment of crops would be about 40 percent they sow about two and half times seeds in the swiddens. Seed of pulses variety are put in dibbled holes. At least three to four seeds are dibbled to ensure that at least one germinate and stand up. The pulses that are of woody variety are dibbled in line and the climbing pulses are dibbled adjacent to the woody ones so that the climbers can grow on the woody plants. The castor seeds are also dibbled in lines. The castor seeds are never dibbled randomly because they are affected by insects. The processes for killing the insects can be easier if the plants are grown in line. Hence, the castor seeds are mostly dibbled on the outer borders of the swiddens. The oil seeds like niger, mustard, sesame are broadcasted. Vegetable seeds are dibbled but in a later time when the moisture in the swiddens increases. No transplanting of vegetables is usually seen.

1. **Scientific validation of shifting cultivation:** In fact, research studies on shifting cultivation in the tropics point, rather, to the strength and resilience of many of these systems, the high returns to labour they offer; and, as importantly, the species enrichment and biodiversity conservation they allow (Reporting DFN Mailing 21, ODI). Considering the nature of economy and economy of nature in relation to shifting cultivation it can be said that it is not completely uneconomic or destructive to environment (Jena, et.al. 2000). Some of the environment specialists took the stand that in the kind of environment in which this kind of cultivation is practiced, it is the most rational form of cultivation, as no other form of cultivation will be possible, or economical ... the so called innocent people know enough about the environment as they take good care of those trees and plants that are regarded by them as useful. ‘In traditional swiddens, agricultural tools are minimal, ploughs are not used and even the harvest is often reaped by hand without the use of a blade. Energy returns for energy input in traditional swiddens is quite high’ (Rappaport, 1972 cf. Jena, et.al. 2014). In ecological terms, swidden cultivation is characterized by its high degree of integration into the natural tropical forest ecosystem, whose characteristics it conserves to a considerable extent (..) it is the ecologically viable

agricultural strategy to have been developed thus far, on a large scale in tropical rain forests, and attempts to apply intensive agricultural techniques brought from other regions have generally been dismal failures, resulting only in the destruction of the ecological balance of the natural rainforest (Seymour-Smith, 1986).

The varieties of crops grown in swiddens are presented in the following table.

Type of crop	Crop name	Sowing – harvesting
Cereals	Maize (Zea mays L.), little millet (Panicum miliare auct.non Lam), finger millet (Eleusine coracana (L.)Gaertn., Sorghum (Sorghum vulgare Pers.), pearl millet or bajra (Pennisetum typhoideum Rich.in Pers.), upland paddy (Oryza sativaL.)	June-July – November-December. Maize is harvested intermittently
Pulses	Pigeon pea (Cajanus cajan (L.)Huth.), cow pea (Vigna indica L.), black gram (Phaseolus mungo L.), green gram (Phaseolus radiatus L.), kaudaka (Vigna), kating , horse gram (Macrotyloma uniflorum(Lam.)Verdc.),lentil(Lens culinaris Medic.in Vorles, French beans(Phaseolus vulgaris L.), carpet legume (Lablab purpureus (L.)Sweet.)	June-July – Nov-Dec. Pigeon pea is the last agricultural product harvested
Vegetables	Pumpkin (Cucurbita maxima Duch.ex Lam), bottle gourd (Lagenaria vulgaris Ser.), ivy gourd (Coccinia grandis(L.)Voigt.), papaya (Carica papaya.L), banana (Musa paradisiacal L.), tomato (Lycopersicon esculentum Mill.), chilli (Capsicum annum L.var acuminatum Fingh.), Capsicum frutescens L.), potato (Solanum tuberosum L.), yam (Dioscorea bulbifera L.), brinjal (Solanum melangina L.), cucumber (Cucumis sativus L.), ridge gourd (Luffa acutangula (L.)Roxb.), cassava (Manihot esculenta Crantz.), sweet potato (Ipomoea batatas (L.)Lam.).	Cropped in June – July. Tubers are harvested during early winter. Other vegetables are harvested intermittently
Spices	Turmeric (Curcuma longa L.), ginger (Zingiber officinalis Rosc.), bird chilli (Capsicum frutescens L.), onion (Alium cepa L.)	Cropped in June-July and harvested in November-December. Bird chilli is harvested intermittently.

Shifting cultivation comprises a range of highly variable and site specific systems that have developed in response to local environmental and cultural conditions. The essentials are that fields are rotated rather than crops and that a forest fallow returns fertility to the soil. Sedentary swidden agriculturists have a strong interest in maintaining the fertility of the village territory and practise a long term conservation measures which

contribute to biological diversity (Mc. Neely, 1989).Watters 1960; Spencer 1966; Ruthenberg 1976; Soemarwoto 1975; Gleissman *et al* 1981; are of the view that the forest dwelling tribal farmers in the humid tropics has managed his traditional rotational bush fallow agricultural system for centuries, with optimum yield on a long term basis, rather than trying to maximize production on a short term basis.

A high species diversity of many tropical ecosystems (Whittaker 1965, 1972) has been considered an important factor in the stability of these natural ecosystem types (Odum 1969; Woodwell and Smith 1969; Mellinger and McNaughton 1975). Such stability in the agricultural production system of is achieved through high species diversity in swidden agro-ecosystem. Apart from the fact that under a transient environment of the steep slopes of the humid tropics, such a high species diversity with a multi-layered crop canopy above would help in multi-layered root mass distribution below the soil which would help in optimal use of nutrient from throughout the soil profile, there are other implications of this in terms of production efficiency. The sowing of multiple crops at one time and the harvesting at different intervals provide more space for the remaining species to grow when they are at their peak growth period.Trenbath 1974 is of the view that with higher crop diversity, it should be possible to combine the need for increased harvestable food portion with the need for maintaining high organic biomass content in the system as a whole. Without this organic matter production it would become necessary to constantly import costly inorganic fertilizers which are hard to come by and whose effectiveness in the face of high temperature and heavy rainfall is questionable (Gleissman 1980; Gleissman *et al* 1981; Ramakrishnan *et al* 198la, b), particularly when the soil is extremely porous contributing to heavy infiltration losses even when the land is terraced (Toky and Ramakrishnan 1981b; Mishra and Ramakrishnan 1983a, Posey 1999). The sequential harvest of crops would provide organic manure to the remaining crop species through efficient recycling of this important resource. Keeping the energy efficiency high, the possibilities of increased crop production has been suggested (Greenland 1975; Revelle 1976; Mutsaers *et al* 1981; Gleissman *et al* 1981) without departing too much from the traditional shifting cultivation system which has been considered as a highly evolved system for the forested areas of the tropics by many workers (Conklin 1957; Carneiro 1960; Nye and Greenland 1975; Warren et al 1975, Rao 1990).Mishra and Ramakrishnan (1984) tend to confirm this, provided the cultivation cycle is kept longer than 10 years.

2. **Bio-diversity in crops:** While the crop diversity and their practice on different lands demonstrate land crop management among the Kondh and Bhunjia, their indigenous knowledge about these aspects show their ecological sense and environmental perception. In comparison to their neighbouring Bhunjia, the crop diversity of the Kondhs in Karlapat presents a varied picture in the sense that the Kondhs grow a greater number of crops in the plains or wetland. There is no doubt that the Bhunjias are relatively disadvantaged in their agricultural operations in comparison to the Kondhs mainly because of locational features. It is also a fact that the valleys in Karlapat area are relatively broader facilitating plain land cultivation. There by the practice of shifting cultivation has been minimized.

XI. LIST OF CULTIVATED PLANTS GROWN UNDER SHIFTING CULTIVATION

CEREALS

Sl. No.	Botanical Name	Family	Local and Vernacular names	Where grown	Subsistence / Cash
1	*Eleusine coracana* (L.) Gaertn.	Poaceae	Mandia	Slopes,foothills	subsistence
2	*Oryza sativa* L.	Poaceae	Dhana	Valleys, foot hills, slopes	Subsistence
3	*Panicum miliaceum* L.	Poaceae	Ralla	foot hills, slopes	Subsistence
4	*Setaria italica* (L.) P. Beauv.	Poaceae	Kangu,Gurji	foot hills, slopes	Subsistence
5	*Sorghum bicolor* (L.) Moench	Poaceae	Ja,jahna,Juar	foot hills, slopes	Subsistence
6	*Triticum aestivum* L.	Poaceae	Gaham	foot hills, slopes	Subsistence
7	*Zea mays* L.	Poaceae	Makka	foot hills, slopes Backyards	Subsistence

PULSES

Sl. No.	Botanical Name	Family	Local and Vernacular names	Where grown	Subsistence / Cash
1	*Cajanus cajan* (L.) Huth.	Fabaceae	Kandula,Harada	Slopes, foot hill plains	Subsistence and cash
2	*Cicer arietinum* L.	Fabaceae	Buta,Butachana	foot hills, slopes	
3	*Lens culinaris* Medic.in Vorles	Fabaceae	Masura	foot hills, slopes	
4	*Pisum sativum* L.	Fabaceae	Matara	Slope, back yard	Cash
5	*Vigna mungo* (L.) Happer	Fabaceae	Biri	Foot hills	Cash
6	*Vigna radiata* (L.) R.Wilczek.	Fabaceae	Muga	Foot hills	Cash
7	*Vigna unguiculata* (L.) Walp.	Fabaceae	Jhudanga	foot hills, slopes	Subsistence
8	*Vicia faba* L.	Fabaceae	kalamatar	foot hills, slopes	subsistence

FRUITS

Sl. No.	Botanical Name	Family	Local and Vernacular names	Where grown	Subsistence / Cash
1	*Carica papaya* L.	Caricaceae	Bhanda	Foot hills,Backyard	Subsistence
2	*Cucumis sativus* L.	Cucurbitaceae	Kakudi	foot hills, Backyards	Subsistence
3	*Musa paradisiaca* L.	Musaceae	Kadali	Foot hills, slopes, Backyards.	Subsistence

OIL SEEDS

Sl. No.	Botanical Name	Family	Local and Vernacular names	Where grown	Subsistence/ Cash
1	*Brassica rapa/ juncea L.*	Brassicaceae	Salgam	foot hills, slopes	Subsistence
2	*Guizotia abyssinica* (L.f.) Cass.	Asteraceae	Pesi,Alasi	foot hills, slopes	Cash
3	*Helianthus annuus* L.	Asteraceae	Suryamukhi	foot hills, slopes	Cash
4	*Ricinus communis* L.	Euphorbiaceae	Jada,Gaba	foot hills, slopes	Cash

GREENS

Sl. No.	Botanical Name	Family	Local and Vernacular names	Where grown	Subsistence / Cash
1	*Abelmoschus esculentus* (L.) Moench	Malvaceae	Bhendi	foot hills, slopes, Backyards	Subsistence
2	*Amaranthus spinosus* L.	Amaranthaceae	Kantaleutia	foot hills, slopes	Subsistence
3	*Amaranthus caudatus* L.	Amaranthaceae	Khada	foot hills, slopes, backyards	Subsistence
4	*Ricinus communis* L.	Euphorbiaceae	Jada,Gaba	foot hills, slopes	Cash
5	*Capsicum annuum* L.	Solancaceae	Lanka maricha	foot hills, slopes, backyards	Subsistence
6	*Celosia argentea* L.	Amaranthaceae	Nahanga	foothills, backyards	subsistence
7	*Chenopodium album* L.	Chenopodiaceae	Bathua saga	foot hills, slopes, backyards	Subsistence
8	*Coccinia grandis* (L.) Voigt	Cucurbitaceae	Kunduri	foot hills, slopes, backyards	Subsistence
9	*Colocasia esculenta* (L.) Schott	Araceae	Saru	foot hills, slopes, backyards	Subsistence
10	*Curcuma zedoaria* (Christm.) Rosc.	Zingiberaceae	Kachura, Gandhasunthi	foot hills, slopes.	Subsistence, Cash
11	*Luffa acutangula* (L.)Roxb.	Cucurbitaceae	Jahni	foot hills, slopes, backyards	Subsistence
12	*Momordica charantia* L.	Cucurbitaceae	Kalara	foot hills, slopes,backyards	Subsistence
13	*Solanum tuberosum* L.	Solanaceae	Alu, Bilatialu	foot hills, slopes	Subsistence
14	*Vigna unguiculata* (L.) Walp.	Vitaceae	Jhudanga	foot hills, slopes, backyards	Subsistence

VEGETABLES

Sl. No.	Botanical Name	Family	Local and Vernacular names	Where grown	Subsistence/ Cash
1	*Abelmoschus esculentus* (L.) Moench	Malvaceae	Bhendi	foot hills, slopes, backyards	Subsistence
2	*Allium cepa* L.	Liliaceae	Uli,Piaja	foot hills, slopes, backyards	Subsistence
3	*Coccinia grandis* (L.) Voigt	Cucurbitaceae	Kunduri,Torada	foot hills, slopes, backyards	Subsistence
4	*Cucurbita maxima* Duch.ex Lam.	Cucurbitaceae	Boitalu,Kakharu	foot hills, backyards	Subsistence
5	*Lablab purpureus* (L.) Sweet	Fabaceae	Simba,Jhata	foot hills, backyards	Subsistence
6	*Luffa acutangula* (L.) Roxb.	Cucurbitaceae	Jahni	foot hills, slopes, backyards	Subsistence
7	*Lycopersicon esculentum* Mill.	Solanaceae	Bilati baigan, Bhejiri, Patalaghanta	Foot hills, slopes, backyards	Subsistence
8	*Momordica charantia* L.	Cucurbitaceae	Kalara	foot hills, slopes, backyards	Subsistence
9	*Solanum melongena* L.	Solanaceae	Baigan	foot hills, slopes, backyards	Subsistence
10	*Solanum tuberosum* L.	Solanaceae	Alu,Bilatialu	foothills, slopes	Subsistence

SPIECES AND CONDIMENTS

Sl. No.	Botanical Name	Family	Local and Vernacular names	Where grown	Subsistence/ Cash
1	*Capsicum annuum* L.	Solanaceae	Lanka maricha	foot hills, slopes,backyards	Subsistence, Cash
2	*Coriandrum sativum* L.	Apiaceae	Dhania	foot hills, slopes	Subsistence, Cash
3	*Curcuma longa* L.	Zingiberaceae	Haladi,Haridra	foot hills, slopes	Subsistence, Cash
4	*Cucurbita maxima* Duch.ex Lam.	Cucurbitaceae	Boitikakharu	foot hills, slopes,backyards	Subsistence
5	*Zingiber officinale* Rosc.	Zingiberaceae	Adaa	foot hills, slopes	Subsistence, Cash

MASTICATORIES AND FUMATORIES

Sl. No.	Botanical Name	Family	Local and Vernacular names	Where grown	Subsistence/ Cash
1	*Nicotiana tabacum* L.	Solanaceae	Dhuanpatra	foot hills, slopes	Cash
2	*Cannabis sativa L.*	Cannabinaceae	Ganjei,Bhanga	Valleys, foot hills, slopes	Cash

XII. AGRONOMIC PRACTICES OF IMPORTANT FOOD PLANTS OF TRIBES

1. **Oryza sativa L. (Family: Poaceae):** It is the principal crop in both Karlapat and Sunabeda area where valley lands are available. It is cultivated on uplands also as a mixed crop.In the month of June-July sowing is done and harvested during the month of September. When taken as mixed crop in swiddens the crops are harvested prior to Vigna mungo which is taken as a mixed crop with paddy. In foot hill valley landsy Cajanus cajan is grown along with paddy.

2. **Zea mays L. (Family: Poaceae):** It is successfully grown in different environmental conditions. The cereal is either grown in the plain dry land or on the hill slope. Fertile and well-drained loamy soil produces the best result. It is taken as a single crop in homestead land or backyards but in swiddens it is taken as a mixed crop with Cucurbita maxima, Cucumis sativus, Vigna umbellata, Vigna mungo, Pennisetum glaucum(Arka/ Kathia,) Eleusine coracana Abelmoschus esculentus, Momordica charantia.

3. **Eleusine coracana (L.) Gaertn. (Family: Poaceae):** It is one of the most important staple food crops. It can be cultivated in extreme dry conditions and low rainfall. The crop can be grown in a variety of soils like well-drained, red, sandy and loamy soil. It can tolerate alkalinity of the soil. So Eleusine coracana is cultivated in all types of land both mixed or singly.

4. **Pennisetum glaucum (L.) R.Br. (Family: Poaceae):** It is always grown as mixed crop with Sorghum bicolor (Gangei), Panicum antidotale & Setaria italica. The crop is sown in swiddens, foot hills and valleys immediately after the onset of the monsoon in early June and harvested during October.

5. **Panicum miliaceum L. (Family: Poaceae):** It is either grown singly or as mixed crop on the hill slopes. The cultivation and harvesting of Panicum miliare is similar to that of the Pennisetum glaucum. Panicum antidotale is cultivated on slopes and foot hill plains. Panicum miliare is cultivated as a single crop during onset of monsoon and harvested during November.

6. **Sorghum spp. (Family: Poaceae):** It exhibits extreme resistance to dry and drought condition. It is cultivated on all types of soil such as sandy soil, heavy and light alluvial soil and red, loamy but best results on clay soil. Here, mixed cropping of Sorghum spp. is very common with other millets. Two varieties such as Black spikelet (kala gangei) and White spiklet (dhala gangei) are usually seen.

7. **Setaria italica (L.) P. Beauv. (Family: Poaceae):** It is cultivated on a variety of soils. It is grown on both red and black soil under rain fed condition. It is always cultivated as a subsidiary mixed crop with others, principally Sorghum bicolor, Vigna unguiculata, Pennisetum glaucum, Eleusine coracana, Cucumis sativus, Zea mays are grown with it.

PULSES

1. **Cajanus cajan (L.) Millsp. (Family: Fabaceae):** The crop is extremely drought resistant. During vegetative growth it requires a hot, moist climate but during flowering

and fruiting period, bright, sunny weather is preferred. It is an annual crop but sometimes the plant is left untouched (not harvested) for the second time, if the growth is found to be healthy. After harvesting of this crop the plant is either cut or grazed by the domestic animals. Cajanus cajan is grown as a dry crop mixed with Oryza sativa. The seed of Cajanus cajan is broadcast very thinly in the rice field and cultivated in swiddens during June-July and harvested in December.

2. **Pisum sativum L. (Family: Fabaceae):** It is grown in cool-growing season on a variety of soils but light sandy soil on valleys and backyards gives the best result.

3. **Vigna unguiculata (L.) Walp. (Family: Fabaceae):** It is grown in swiddens. It is sown in the centre of the plot and is surrounded by

GUIZOTIA ABYSSINICA.

1. **Vigna mungo (L.) Hepper (Family: Fabaceae):** It is cultivated in kharif season in swiddens with gentle slope and foot hill plains. In the swiddens it is taken as a mixed crop. It is sown in the month of June and harvested during August or September.

2. **Vigna radiata (L.) R.Wilczek (Family: Fabaceae):** It is cultivated on a variety of soils but medium loamy soils are the best. It is grown mainly as a kharif season crop in foot hills mostly as a pure crop.

3. **Lens culinaris Medik. (Family: Fabaceae):** It is generally grown as a cold season crop. The sowing time extends between October-December and the crop is cultivated generally as a dry un-irrigated crop with the help of subsoil moisture and heavy dews in this season. Since it is a short duration crop, it becomes ready for harvest in about 3 months, sown in February and harvested in April.

4. **Vigna unguiculata (L.) Walp. (Family: Fabaceae):** It can be grown in any type of soil. In foothills the seeds of Vigna unguiculata are sown with Pennisetum glaucum, Eleusine coracana, Setaria italica, Cucumis sativus and Zea mays. Sowing is done in the month of June-July and harvested during the month of September-October.

5. **Vicia faba L. (Family: Fabaceae):** This crop grows best on plain land. The crop is sown in one corner of the plot or near other crops of the plot or grown near the field bunds. The seed is sown line by line by hand dibbling. For the plant to twine, supporting twigs and branches are fixed with the crop. Sowing is done in December and harvested in January

6. **Cicer arietinum L. (Family: Fabaceae):** The crop is best grown in moisture containing soil. Generally Cicer arietinum is grown purely in near river or stream banks. The seed is broadcasted in close proximity because the plant does not spread extensively. Sowing is done in December and harvested in March.

VEGETABLES

1. **Colocasia esculenta (L.) Schott. (Family: Araceae):** Rhizomes are planted in the ditches of the swidden plot. For proper growth the pit or ditches are filled with litter,

ashes and decomposed plant parts as fertilizers. It is also grown in rows in the backyards especially under shade. It is planted in July and harvested during January to March.

2. **Solanum melongena L. (Family: Solanaceae):** Sandy loamy soil is suitable for better growth of this plant. This is generally cultivated as a backyard crop round the year. Each plant is stumped once or twice for coppicing. The coppice gives good yield. This way the community members avoid frequent planting. Cared properly, one plant can provide vegetables round the year.

3. **Luffa acutangula (L.) Roxb. (Family: Cucurbitaceae) :** It is cultivated in backyards. Small pits are dug out and these are filled with manure. Then seeds are dibbled in those pits. Luffa acutangula plants grow on the roof of houses or trees nearby.

4. **Momordica charantia L. (Family: Cucurbitaceae):** It is grown mixed with Zea mays, Abelmoschus esculentus, Cucumis sativus and Gossypium arboreum in backyards. The plant creeps on the land or on neighbouring plants.

5. **Abelmoschus esculantus (L.) Moench (Family: Malvaceae):** This crop is grown in the backyards and cultivated as a mixed crop. The seed is broadcasted thinly with Zea mays, Cucurbita maxima, Cucumis sativus, Vigna umbellata, Mormordica charantia after ploughing.

6. **Coccinia grandis (L.) Voigt (Family: Cucurbitaceae) :** It is propagated by vegetative method only. This plant is grown from its young stem. Generally the plant is cultivated in backyards near hedges, but if hedges are absent then artificial supports are given. Small pits are dug out and manure added. Then a two feet long young plant stem is planted there. Planting is done in Jun/July and harvested in August-September.

7. **Lycopersicon esculentum Mill. (Family: Solanaceae):** It is cultivated in backyards and planted in rows. It can grow well under humid condition.

8. **Cucurbita maxima Duchesne (Family: Cucurbitaceae):** It is a crop that is grown in all conditions, all types of soils and as a regular vegetable. In swiddens this is taken as a mixed crop and in kitchen gardens and backyards it is grown near a tree or house so that the climber could spread over. This is mainly planted as a kharif crop.

9. **Musa paradisiaca L. (Family: Musaceae):** It is usually grown in the backyard of houses or in well-fenced areas in and around Kondh and Bhunjia habitat. The crop grown near water sources grow luxuriantly and yield better. However, it is also grown in swiddens near the watch huts and also on the stream banks. There are endemic as well as exotic varieties grown.

10. **Carica papaya L. (Family: Caricaceae):** It is grown in the kitchen garden (Badi). This crop grows best in fertile, humus and ash-containing soil. Seed propagates the plant. Mostly they are transplanted during rainy days.

11. **Solanum tuberosum L. (Family: Solanaceae):** The crop is mainly cultivated in winter season in the kitchen garden and orchards. It adapt well to a number of soil types and

climates. To cultivate the crop, land is repeatedly ploughed and well manured. Planting is done on beds and while planting the soil is lightly drenched with water. Generally in the month of December the seeds are planted and harvested during February/March.

12. **Ipomoea batatas (L.) Lam. (Family: Convolvulaceae):** It requires a warm moist climate and long growing season. The crop is grown on different types of soil but sandy soil is the best. The crop is cultivated in well ploughed and raised beds. This crop is propagated vegetatively by vine cuttings obtained from the crops of previous year or by sprouts coming out of cut pieces, which are planted with good spacing. The crop is harvested when the soil is dry, and weather is free from humidity. When the leaves turn yellow and drop off the tubers are considered to be ripe. Planting is done in July and harvesting made in January.

13. **Dioscorea bulbifera L. (Family: Dioscoreaceae):** It grows in any type of soil but ash or sandy soil is better for its growth. This crop is usually propagated by the use of small tubers, pieces of tubers or bulbils. It is inter-cropped in hedges in kitchen gardens and homestead lands. In swiddens where the soil depth is good and the soil is lighter it is planted just before or at the commencement of the rains and are dug out by hand with the help of iron or wooden instruments. The wild boars destroy the crop in swiddens and hence the local people are restraining from cultivating the tuber in swiddens.

OIL SEEDS

1. **Brassica rapa L. (Family: Brassicaceae):** It is one of the main oil yielding crops, which is grown in the plain land near the villages. Just after harvesting the maize, the field is sown with Brassica rapa. Soil with good moisture is favorable for its growth but water logging is harmful to the crop. The crop is sown towards the end of monsoon (September) and do not need any irrigation.

2. **Helianthus annuus L. (Family: Asteraceae):** It is a recent addition in the list of crops grown by Bhunjias and Kondhs. The agriculture and horticulture department have been promoting this crop in the backyards, homestead lands and also on foot hills. It is taken as an economic crop only as the local tribals do not have provisions for milling the seeds for oil. The cultivation starts in the rainy season and is harvested in the winter.

3. **Ricinus communis L. (Family: Euphorbiaceae):** This crop is not an indigenous crop in this locality and is cultivated by some people in the backyards and also along the outer lines of a swidden. Oil is extracted from the seeds.

SPICES

1. **Zingiber officinale Roscoe (Family: Zingiberaceae):** It has now become a common crop in this area. This crop is also being promoted in the sanctuary area as the crop fetches good economy. Important is that the crop is not raided by the wildlife and hence damage to the crop is least. Ginger can thrive well in sandy or clayey-loam, red loam or laterica loam soils. It requires a warm and humid climate for its better growth. The local people are taking up this crop in swiddens and using the methods like mulching for better growth and ginger production. The rhizomes are planted on ridges. Ginger cultivation in

swiddens also help in moisture retention in the soil as the rhizomes are planted on ridges and the moisture is trapped in alternate furrows.

2. **Curcuma longa L. (Family: Zingiberaceae):** Both Kondh and Bhunjia families grow it. The crop thrives best in loamy or alluvial fertile soil. The crop is mostly cultivated on the fringe of swiddens. As an aromatic crop it is not raided by wildlife. It is planted during rainy season and harvested towards end of winter season.

3. **Capsicum annuum L. (Family: Solanaceae):** Capsicum annum and Capsicum frutescens are cultivated in swiddens as well as in backyards and orchards. Well-tilled, loamy, fertile soil gives best results. This crop is cultivated both as monoculture and mixed with other crops.

4. **Coriandrum sativum L. (Family: Apiaceae):** It is a widely used aromatic crop cultivated in the kitchen gardens. Sandy, loamy soil is the best for its growth. The seeds are sown by broadcast method. The young leaves are used as leafy vegetables. After maturity the seeds are used for spices.

XIII. FUMATORIES AND MASTICATORIES

The stimulating substances, which are used for smoking, are called fumatories and those used for chewing are called masticatories.

1. **Nicotiana tobaccum L. (Family: Solanaceae):** In a certain edaphic and climatic condition the tobacco plant can grow well. A light, loamy-sandy soil which is rich in humus and well fertilized having potash, lime substances, is the best for its growth. Tobacco is chiefly cultivated both as Kharif and Rabi crop in kitchen gardens and orchards. The plants are propagated from seeds. The seeds are sown in seedbeds and allowed to grow till they attain 4-6 inches height. After 5-10 weeks of growth, the seedlings are transplanted to a well-cultivated field. The field has to be considerably aerated and manured both before and after transplantation.

2. **Cannabis sativa** L. **(Family: Cannabinaceae):** In many remote corners in swiddens, avoiding the eyes of the excise department the locals grow cannabis as an economic crop which they sell very secretly. The swiddens are best places for the crop as the soil remains drained and dry.

XIV. PERCEPTION ON GENETIC EROSION OF PLANT DIVERSITY

A list of the plant species, which face such disastrous or alarming consequences, is given below.

Azadirachta indica A. Juss. Syn: Melia azadirachta L. (Family: Meliaceae) L (O): Nimba Eng: Margosa Tree, Neem Tree All local communities in Sunabeda and Karlapat area consume its tender leaves and fruits. Its bark and leaves are used as medicine and leaf is used as insect repellant both in house and fields. Although the local ecological condition in the Bhunjia area suits the growth of this plant better, yet due to its pesticidal effects the plant is over exploited especially for the purpose of agriculture. Further, the neem seeds are collected

for sale in market. While collecting the seeds the community members nearly sweeps the forest floor leaving no seed for germination. This way the population of the trees decline.

Bambusa bambos (L.) Voss Syn: Bambusa arundinacea (Retz.) Roxb. (Family: Poaceae) L(O): Baunsa Eng: Common Bamboo The tender succulent shoots (locally called karadi) make delicious dishes of the local communities, especially during the rainy season. Apart from the Kondhs and Bhunjias, the Paharia community depends largely on bamboo with which they make various items and crafts that they sell in market for their subsistence. The indiscriminate collection of bamboo shoots on one hand and the extreme dependency of local communities for bamboo crafts are main reasons for destruction of bamboo bushes in the locality. That apart, according to local people in Karlapat area, the elephants also destroy good number of bushes every year hampering the bamboo production.

Buchanania lanzan Spreng. Syn : Buchanania latifolia Roxb (Family : Anacardiaceae) L(O) : Char, Piora, Pialo Eng : Almondette, Cuddapah Local communities consume ripe fruits and seed kernels. The seeds are of great demand in the nearby Chhatisgarh markets for which there is always a competition among the community members to collect the maximum seeds available. In the competition, the children also get engaged and they go on collecting the seeds even before they matured. The tree is moderately distributed and when all the seeds are collected, even before they are properly mature, there remains no seed left in the forest for germination. Hence the naturally growing population of the species is greatly hampered.

Careya arborea Roxb. (Family: Lecythidaceae) L(O): Kumbhi Eng: Kumbi, Slow match tree The population of the species is dwindling fast because of extraction of bark fibres for use as ropes. Further, since the tree is less important as NTFP, there is very little attention given to maintain population of the trees. In the swiddens age old trees have been girdled (a ring of bark is removed) that causes drying and death of the trees. The swiddeners use such a method to escape from being accused of felling a tree. Due to these reasons the population is declining.

Caryota urens L. (Family: Arecaceae) L(O): Salapa, Sadapa Eng: Fish Tail palm, Toddy palm, Kittul palm, Sago palm Its fresh sap is a favourite of the Kondh and other local community members. The Bhunjias are also fond of its sap. The sap is also fermented by using many intoxicating agents of plant origin like rice, bark of cassia fistula, root of Cissampelos pareira and fermented part of the inflorescence stalk which was scraped. Usually, the inflorescence is cut and tapped for toddy. Due to that the seeds are not produced which hampers the natural propagation of the tree. The tree is also hardly transplanted and whenever transplanted by picking up seedlings from forests the survival is very low. The toddy tapping is the main reason for decline in population of the tree.

Firmiana colorata (Roxb.) R. Br. Syn: Sterculia colorata Roxb., (Family: Sterculiaceae) L: Panikodal The local people collect resin from this plant. Generally they make incision on the tree trunk and the mucilage of the plant exudes out through this passage. Then after a few days this mucilage is solidified at the place of blaze. This solidified mucilage or resin is collected and sold in the local market. Due to continuous incisions for unsustainable exploitation of gum the bark of the tree dries up leading to drying up of the tree.

Gmelina arborea Roxb. (Family: Verbenaceae) L: Gambhari, Bhadraparni Eng: Coomb Tree, Gumbar Tree The local communities use timber of the tree for making agricultural implements and cots. The wood is light and strong that makes it the first preferred wood for agricultural implements and small household artifacts. The timber is also used as feeding container for cattle and other domestic small ruminants. Many young trees are felled for this reason that threatens population of the tree.

Haldina cordifolia (Roxb.) Ridsdak Syn: Adina cordifolia (Roxb.) Hook.f. ex. Bran. (Family: Rubiaceae) L: Halanda, Maldu L(O): Kuruma This tree was abundantly found on the hill-slopes and in mixed forests. This tree has become victim of shifting cultivation on hill slopes. In the reserve forests and within core sanctuary area the tree population has not dwindled, although, however, in comparatively open forests the dwindling population is well observed.

Kydia calycina Roxb. (Family: Malvaceae) L: Juta L(O): Kapasia, Banakapasia Using bark of this plant the local communities make rope and grain bin. To collect bark of the tree the locals chop down the plant and extract bark starting from lower side of the plant. The rope is used in many common purposes as the fibres are thin, strong and light. Over exploitation of the plant has become a cause of concern. Usually the plant is found abundantly in moist and canopy forests compared to the dry and open forests and also in secondary forests.

Litsea glutinosa (Lour.) Robins. Syn: L. sebifera (Willd.) Pers. (Family: Lauraceae) L: Baghaoiri, Baghatala L(O): Krushnakedar It is a small tree. Its bark has got high market demand, for its bark is used in making of incense sticks. The local traders indirectly promote the unsustainable exploitation of the barks ignoring health of the plant. Both men and women who regularly visit forest for various needs engage themselves in peeling bark of the plant for sale in the market. No tree that comes in sight is spared from bark collection. This ruthless activity by the locals has caused enormous damage to population of the species and has endangered survival of the species in the long run.

Mesua ferrea L. (Family: Clusiaceae) L: Nageswar L(O): Nagakedar Eng: Mesua tree This tree is of very few occurrences in the Karlapat and Sunabeda sanctuary area. The Hindu community has many religious notions attached to this tree. However, the tribal communities indiscriminately fell the tree because of its timber that is used for making drums. There is good demand of the wood for making musical instruments and crafts for which the wood is smuggled out causing fast decline in its population.

Nyctanthes arbor-tristis L. (Family: Oleaceae) L: Gotikhadika, Gangasiuli L(O): Singadahar, Sephali, Gangasiuli Eng: Coral/Night Jasmine This is a very well known preventive and ameliorative drug for malaria. Since malaria is very common in the locality the leaves of the plant is frequently collected by the local communities. Sometimes, to collect the leaves people do not mind felling the whole tree. Some local vaidyas also sell the leaf extract with a sugar base in the local market for prevention and cure of malaria. Because of such practice the population of the species is declining in the forests although the domestication of the plant is growing significantly.

Oroxylum indicum (L.) Vent. (Family: Bignoniaceae) L: Phamphunia, Pampania L(O): Phanphana It’s a small to moderate high tree which is very rarely available in Sunabeda and

Karlapat area. It is a known medicinal plant as well as a plant yielding fibres for various uses. It is exploited by the locals for medicine as well as artifacts. That apart in Karlapat area the extensive shifting cultivation is another reason for mass elimination of the trees. Unsustainable exploitation causes decline in population of the tree.

Phyllanthus emblica L. Syn: Emblica officinalis Gaertn. (Family: Euphorbiaceae) L: Amla, Aonla Eng: Emblic myrobalan, Indian Gooseberry According to the local people this tree was abundantly found in the forests and their population has dwindled due to over exploitation and unscientific harvesting. Since, there is a ready market for amla people go for early collection of its fruits even when the fruits are quite immature. While some people use hooks to pluck the fruits, some cut the branches and twigs to collect. When collected, people nearly sweep the forest floor and do not leave any ripe fruits for seeds. During the Hindu rituals and festivals the tribal people also break the twigs of the plant for selling in the market, which eventually, harm the tree and lead to its death. On one hand the unscientific practice for collection goes on and on the other hand no ripe fruits and seeds are left in forest restricting the natural propagation of the species.

Rauvolfia serpentina (L.) Benth. ex Kurz (Family: Apocynaceae) L: Patalgaruda, Patalgirida Eng: Rouvolfia root, Serpentine root Its roots are used for medicinal purposes. Therefore, the demand for this plant is very high among the users. Both the Kondhs and Bhunjias collect the roots of these plants by the method of uprooting or digging and sell them in the nearby local markets. Very often, the local vaidyas insist the locals for more and more collection of roots of the plant which becomes a major factor for massive uprooting of plant.

XV. ETHNO-ECOLOGICAL PERCEPTIONS BY LOCAL TRIBES

1. **Knowledge of appropriate time for tree felling:** The community members in both Sunabeda and Karlapat area have perceptions on appropriate time for tree felling. According to them, any tree felled for any purpose; starting from agricultural implements to high value furniture's, should be done during dry seasons i.e. during middle of winter to beginning of rainy season. According to them in wet months due to more moisture in the tree as well as because of humidity in the surrounding the timber gets fungus infested. Fungus grows on the cut parts of the timber and leave blemishes like impressions that also spread through the timber. When the timber is sliced spots would be found all over the wood. In their words timbers grow spots (suri) if felled during wet months. Going by this understanding people always wish to fell trees during dry months but as the sanctuary management becomes coercive against the communities so they are impelled rather to fell trees during rains avoiding vigilance of forest department.

2. **Collection of medicinal plants:** The community members are of view that plants intended to be used for medicine purpose should always be collected from the core forests and should never be collected from near termite mounds, cremation grounds, from cultivated fields and road sides. In their view plants in such areas lose their medicinal efficacy. Knowledgeable people always suggest collecting medicinal plants from deep forests where the plants are growing with their wild relatives. The medicine men hold that plants retain their best active principle when grows in groups with other affinal community members.

3. **Collection of tubers:** The tubers should be collected for food during dry seasons only. It is so advised because while digging tubers people dig deep pits where water logging would obviously happen in rainy season. Water logging in the pits destroys the tuber and its reproductive vegetative parts also. Hence, as a practice they follow such traditions and thereby help conservation of the species. It is also a habit of the communities that while exploiting tubers they do not take the whole plethora home rather leave some parts for further germination and growth. Such habits prevent genetic erosion.

4. **Weeds are better insect repellents:** A general conception with the local community is that the weeds growing with cultivated crops have good insect and pest repellent qualities. This idea is borne out of their long observation that during the most optimum time for pest infestation the weeds remain unaffected and remains in good health. Hence, some people started experimenting with the extracts of weeds to reduce pest infestation. Now it has been a regular practice to use the weeds; as extracts and powders and in mixture with cow urine, ash, charcoal powder, etc on cultivated crops to prevent and control pest infestation.

5. **Silvicultural perceptions:** Local people often dishonor so called scientific practices in silviculture and observe them as counterproductive practices. One startling explanation is weeds cleaning from the plantation areas. Inside the sanctuaries and in fringe areas forest department has raised Sandal wood plantations. Every year, as part of silvicultural practices the plantation areas are de-bushed and weeds are cleaned. According to the locals, sandal wood roots are not able to drink water, rather it adjusts its roots with other weeds to intake water. They believe that if weeds are cleaned from the root area of Sandal wood then their growth would be stunted leading to its death.

6. **Genetic erosion:** According to the locals loss of primary forest means loss of endemic biodiversity from the area. All efforts in re-growing the forests as secondary forests cannot bring back the lost genetic diversity. Logically they are of the view that if the shifting cultivation practice is totally abandoned or if the lands are left under permanent fallow even then certain species would never come back. They argue, basing on such as understanding, that the area affected under shifting cultivation should altogether be converted to agricultural lands. Where the forest is not much depleted, they may be left un-interfered to restore the genetic diversity.

7. **Restriction on NTFP collection and impact on biodiversity:** The sanctuary management restricts the local communities from collection of NTFPs from inside the sanctuary in the name of scientific management and biodiversity conservation. Local communities raise questions if such restrictions do any good to the forest biodiversity. What is understood from local communities is that the sanctuary management rules deny their access into the sanctuary forests for collection of sal seeds or myrobalans including amla which makes their major collections, in Karlapat area. Similarly, in Sunabeda area the Tendu leaf collection from inside the sanctuary is restricted by which they lose a good part of their earning. There is plenty of production inside the sanctuary and all NTFPs are not related to the food habits of the wildlife. The seeds fall in the forest, germinate in clusters and few of them survive and grow. That way restriction on collection of seeds goes against the principles of nature in the local's perspective. On a global perspective, especially in the context of Convention of Biological Diversity it goes against the clause

'sustainable utilization of biodiversity'. From observations, the local people are of the view that wildlife has their own territory and seed dispersal through them remains confined to their critical habitat only. To aid seed dispersal and natural process of regeneration in depleted areas the human intervention is highly necessary. Hence, in the local's perspective, such banning of NTFP collection hardly contribute to ecological health of the forest.

8. **Restrictions on grazing and forest ecology:** Sanctuary rules also do not allow open grazing inside the sanctuary. This is justified on the ground that such a ban restricts spread of diseases and epidemics borne by livestock. Thought from a different perspective, the livestock browse upon certain flora which coppice very fast. Further, the livestock grazing remains confined to sanctuary fringe areas only. Hence, the local logic stands that the livestock grazing does not hamper the ecological health of the sanctuary rather, unconsciously and indirectly, it helps the forest ecology. The local argument goes that livestock leave dungs inside the forests that add to already existing organic matters in the forest. What is more important is that the tiny holes created by the boots of the ruminants inside the forest helps as seed traps wherein the seeds get arrested during a surface run off. Incidentally such boot holes also retains some moisture that helps the trapped seed to germinate. The local's experiences and observations also carry important hints for better maintenance of regeneration of biodiversity in the forests.

9. **Soil and moisture conservation:** The local people employ many traditional methods and technology for conserving soil and water which aids the sanctuary biodiversity in a big way. The local communities have pragmatic observations on strategic locations where soil and water conservation interventions should be done and using their experience and understanding of the area they are able to design and build structures with least inputs in terms of labour and material without disturbing the natural processes. Such experience and local knowledge based structures are much more stable. Even then such knowledge systems are rarely taken into consideration by the sanctuary management.

XVI. CONCLUSION

The existing PAs need to be assessed for their effectiveness, and they should be covered by an appropriate management plan. Measures are to be properly planned and implemented for biodiversity conservation, Buffer-Zone management, wildlife conservation and watershed protection. Potential for development of eco-tourism, participatory eco-development, other non-destructive uses of resources, and wildlife farming need to be investigated and suitable programmes developed. Creating options for better wildlife management intending to restore harmonious man-plant-animal interactions for a healthy environment is need of the hour and a tough challenge too. In India the PAs policies have to be contend with an ever increasing number of objectives competing with each other. While there is little dispute about the fact that conservation of wildlife and biodiversity of plants *in-situ* is the main objective it has to be balanced with the survival needs of the communities. Assistance to the local population in solving their day to day problems will certainly go a long way in winning their acquiescence for restrictions on their living conditions in PAs.

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